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Artigo Original

Original Article

Comparison between clinical and videofluoroscopic evaluation of swallowing in children with suspected dysphagia

Comparação entre as avaliações clínica e videofluoroscópica da deglutição em crianças com suspeita de disfagia

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Keywords

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ABSTRACT

Purpose: To verify the accuracy of clinical evaluation compared with videofluoroscopic swallowing studies in the detection of isolated laryngeal penetration and laryngeal aspiration in children with suspected dysphagia; to identify clinical signs and symptoms associated with isolated laryngeal penetration and laryngeal aspiration; and to determine the sensitivity and specificity of the clinical signs and symptoms identified. **Methods:** Retrospective analysis of data from clinical and videofluoroscopic evaluations carried out in 55 children from 1 month to 7 years and 11 months old. For clinical assessment, the Protocol for Clinical Assessment of Pediatric Dysphagia was used. The sensitivity, specificity, and positive and negative predictive values of clinical evaluation were analyzed. For statistical analysis, the Fisher's exact and χ^2 tests were used. **Results:** Clinical evaluation showed, in general, a sensitivity of 86% and a specificity of 32%. For isolated laryngeal penetration, clinical evaluation showed a sensitivity of 88%. For laryngeal aspiration, clinical evaluation showed a sensitivity of 86%. However, the specificity values were low for both alterations. There was no association between clinical evaluation and videofluoroscopic findings. Choking was the only clinical sign associated with isolated laryngeal penetration thin fluid and showed a sensitivity of 53% and a specificity of 77%. **Conclusions:** Clinical evaluation was sensible to detect isolated laryngeal penetration and laryngeal aspiration in children with suspected dysphagia. However, it showed a low specificity. Choking was the only clinical sign associated with isolated laryngeal penetration of thin fluid. More prospective studies are needed to confirm these findings in this population.

Descritores

Lactente
Criança
Fluoroscopia
Transtornos de Deglutição
Avaliação
Sensibilidade e Especificidade

RESUMO

Objetivos: Verificar a acurácia da avaliação clínica da deglutição comparada à videofluoroscopia na detecção de penetração laríngea isolada e aspiração laríngea em crianças com suspeita de disfagia; identificar os sinais e sintomas clínicos associados à presença de penetração laríngea isolada e aspiração laríngea; e determinar a sensibilidade e a especificidade dos sinais e sintomas clínicos identificados. **Métodos:** Análise retrospectiva de dados de avaliações clínicas e videofluoroscópicas realizadas em 55 crianças de 1 mês a 7 anos e 11 meses de idade. Na avaliação clínica foi utilizado o Protocolo de Avaliação Clínica da Disfagia Pediátrica. Foram analisados: sensibilidade, especificidade e valores preditivos positivo e negativo da avaliação clínica. Também foram utilizados os testes exato de Fisher e do χ^2 na análise estatística. **Resultados:** A avaliação clínica apresentou, no geral, sensibilidade de 86% e especificidade de 32%. Para penetração laríngea isolada, a avaliação clínica apresentou sensibilidade de 88%. Para aspiração laríngea, a avaliação clínica apresentou sensibilidade de 86%. Contudo, os valores da especificidade foram baixos para ambas as alterações. Não houve associação significativa entre a avaliação clínica e os achados videofluoroscópicos. O engasgo foi o único sinal clínico associado à penetração laríngea isolada com líquido fino e apresentou sensibilidade de 53% e especificidade de 77%. **Conclusões:** A avaliação clínica foi sensível para detectar penetração laríngea isolada e aspiração laríngea em crianças com suspeita de disfagia, porém, apresentou baixa especificidade. O engasgo foi o único sinal clínico associado à penetração laríngea isolada com líquido fino. São necessários mais estudos prospectivos que confirmem esses achados nessa população.

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INTRODUCTION

Children with suspected dysphagia are referred to swallowing assessment, which is performed clinically, and, if necessary, complemented with an objective evaluation, such as videofluoroscopic swallowing study (VFSS).

The VFSS is the gold standard objective evaluation of swallowing for, among other advantages, accurately detecting changes in the pharyngeal phase[1], which is the main objective in children assessments[2]. However, this method has some disadvantages such as exposure to radiation, limited test time, which does not simulate a real meal, and the need for patient compliance, which also affects the results[1-3].

In some cases, VFSS may not be necessary or may not be available for professionals in an institution, so they must define their actions based only on clinical judgment[4], in which the pharyngeal phase of swallowing cannot be assessed objectively and the presence of silent aspiration may not be identified. However, changes can be inferred through clinical signs and symptoms (CSS), suggesting changes in the pharyngeal phase of swallowing and coughing, choking, cyanosis, wet voice, change in cervical auscultation, among others[5-7].

Some studies have compared the clinical evaluation with VFSS in children with cerebral palsy and showed that clinical evaluation may, at times, not be able to detect changes in the pharyngeal phase in this population[8,9] due to the low accuracy[9]. In another study, among ten children with CSS suggestive of laryngeal aspiration, eight were identified in the VFSS[7].

In children with neurologic disorders, a study found a significant correlation between cervical auscultation and hyoid excursion, and between larynx and the presence of liquid and paste laryngeal aspiration[10].

A study conducted with children with feeding problems showed that clinical assessment can detect penetration and aspiration of fluids, but had low accuracy with solids[4].

By comparing CSS suggesting alterations in the pharyngeal phase with the findings of the VFSS, studies have shown that cough was the main indicator of penetration with liquids[4] and that wet voice, noisy breathing[11], and cough were good clinical indicators of laryngeal aspiration with liquid[4,11,12]. However, no clinical signs were significantly associated with aspiration, penetration, or post-swallow paste residue[11].

There are few studies in literature evaluating the accuracy of clinical assessment compared to the VFSS in children. A study aiming to verify the sensitivity of clinical evaluation to identify aspiration reported 92% sensitivity for liquids and 33% for solids[4]. Another study observed a 91.6% sensitivity in clinical evaluation to detect changes in the pharyngeal phase[13].

In children with cerebral palsy, studies have shown that the accuracy of clinical assessment in the diagnosis of dysphagia is low and similar for paste (52.2%) and liquid (53.4%)[9]. Furthermore, the sensitivity of clinical evaluation (80%) is higher than the specificity (47%) to detect penetration or aspiration[14].

Some studies have reported the sensitivity and specificity of CSS associated with changes in the pharyngeal phase found by the VFSS, with the following results: 62% sensitivity and 72% specificity for change in cervical auscultation related to penetration or aspiration[15], 67% sensitivity and 53% specificity for cough, 67% sensitivity and 92% specificity for wet voice, and 33% sensitivity and 83% specificity for noisy breathing when stating aspiration of thin liquid[11].

On the basis of the earlier-mentioned results, the importance of further studies comparing clinical evaluation with VFSS and verifying the accuracy of clinical assessment to detect changes in the pharyngeal phase in children is highlighted. The objectives of this study were the following:

1. To check the accuracy of clinical evaluation of swallowing (CES) compared to the VFSS to detect laryngeal penetration and isolated laryngeal aspiration in children with suspected dysphagia.
2. To identify CSS associated with the presence of laryngeal penetration and isolated laryngeal aspiration.
3. To determine the sensitivity and specificity of CSS identified.

METHODS

The project was approved by the Research Ethics Committee of the institutions that conducted the study, with protocol numbers 213/11 and 1118/11. This was a retrospective analysis of data and of CES and VFSS carried out from January 2011 to December 2013 in children aging 1 month to 7 years and 11 months, referred from the pediatric intensive care unit, the nursery and Speech Language Pathology and Audiology clinics of the institution.

Participants

As to selection of subjects, the children included aged 1 month to 7 years and 11 months, with clinical suspicion of dysphagia and who had undergone CES and VFSS. Children without CES report, those not submitted to oral and/or pharyngeal phases of swallowing in VFSS, and those assessed by CES with different consistencies compared to VFSS, disabling comparison, were excluded from the study.

Data collected from medical reports were the following: date of birth, gestational age at birth, gender, peri- and postnatal intercurrences, and current medical diagnoses.

Procedures

For CES, we used the Protocol of Clinical Evaluation of Pediatric Dysphagia (PAD-PED)[16], which was developed based on the literature addressing clinical evaluation of dysphagia, considering the particularities of the dynamics of child swallowing. This assessment was made by the speech therapist of the institution, experienced and specialized in child dysphagia. In this study, we considered only the items referring to CSS, suggesting alterations in the pharyngeal phase of the consistencies evaluated: change in cervical auscultation, change in voice quality, changes in vital signs (heart rate, respiratory rate, and oxygen desaturation), coughing, choking, cyanosis, paleness, and respiratory distress.

For changes in cervical auscultation, when respiratory sounds were observed after swallowing[17], the following items

were considered: basic change with worsening after the offer, change during the offer, and change after the offer.

Similarly, for changes in voice quality in the presence of wet voice, characterized by a bubbling sound that indicates presence of secretions or food in the laryngeal vestibule[18], the following items were considered: change after the offer with and without spontaneous clearance.

For cough, effective cough and ineffective or late cough were considered.

For the registry of change in vital signs, the following parameters were followed:

- Change in heart rate: decrease or increase in heart rate during swallowing, based on the values of 80–160 beats per minute (bpm) for the age group 0–2 years, and between 70 and 120 bpm for children aging 2–7 years and 11 months, considered to be adequate[19].
- Change in respiratory rate: decrease or increase in respiratory rate during swallowing, based on the values of 30–40 breaths per minute for children aged less than 1 year, and between 20 and 30 breaths per minute for those aging 1–7 years and 11 months, considered to be adequate[19].
- Oxygen desaturation: reduction greater than 5% in the baseline index after swallowing[16,20].

The VFSS was performed with an interval of at least 48 hours after CES. The examinations were performed by the radiologist and the speech therapist using Philips Duo Diagnostic equipment, collimated field in the area of interest, with exposure parameters set automatically by ionization chamber, thus capturing the best image with the least fluoroscopic radiation dose.

To record VFSS, infants were placed in the supine position with a compressor belt, for safe retention, and older children in sitting position and side view, as close as possible to the tabletop and to the enhancer, thus avoiding distortion of the fluoroscopic image.

The consistencies evaluated were mixed with barium sulfate contrast and offered to the children with their current use handpiece (bottle with common or orthodontic nipples, cup, or spoon). The focus of the fluoroscopic image was limited to the anterior region by the lips, the upper region through the nasal cavity, in the back of the cervical spine, and the lower region of the airway bifurcation and cervical esophagus.

In VFSS, changes in laryngeal phase that impacted the safety of oral feeding were considered, specifically the following:

- Isolated laryngeal penetration: food in the laryngeal vestibule, but not exceeding the level of the vocal folds[21], observed in the absence of aspiration in any swallowing of a given consistency[11]. This happens because of the delayed onset of pharyngeal swallowing, decreased pharyngeal contraction, or decreased laryngeal closure[2,18,22], and is considered a risk factor for aspiration[6,11,23].
- Laryngeal aspiration: passage of food below the level of vocal folds, reaching the trachea[2,18,21] due to the delayed onset of pharyngeal swallowing, decreased pharyngeal contraction, or decreased laryngeal closure, and can occur before, during, or after swallowing[2,18,22].

The evaluation of accuracy and association between CES and videofluoroscopic findings was performed in general and according to the food consistency. The association between CSS and videofluoroscopic findings was assessed according to the food consistency.

Statistical analysis

The accuracy of a diagnostic test is evaluated by comparing its results with those of a gold standard, and checking rightness capacity. In this study, verifying the accuracy of CES using VFSS as gold standard was expressed by sensitivity (fraction of true positives among those presenting changes), specificity (fraction of true negatives among those without changes), positive predictive value (proportion of true positives among those presenting clinical sign), and negative predictive value (proportion of true negatives among those without clinical sign) calculations.

In addition to these proportions, to determine the association between the CES, CSS, and videofluoroscopic findings, the Fisher's exact test and the χ^2 test were used. The significance level of 0.05 was adopted.

RESULTS

Within 24 months (January 2011 to December 2013), 85 children were submitted to VFSS; of which, 30 were excluded for not meeting the criteria adopted in this study, totaling 55 subjects (30 males and 25 females). The subjects aged from 1 to 81 months, mean 14 months.

Diagnoses were divided into neurological problems, heart and lung, and others (Chart 1).

In the evaluations, 14 children (25%) were using alternative feeding route (2 gastrostomy, 2 orogastric tube, and 10 nasogastric tube). No child had tracheostomy. The children were evaluated by CES and VFSS with food consistency appropriate for their age group and according to speech treatments. Thus, among 55 children, 45 were evaluated with thin liquid, 21 with thick liquid, and 18 with homogeneous paste.

Overall, 80% children had CSS suggesting changes in the pharyngeal phase at CES, and changes in the cervical auscultation (49%), cough (35%), choking (35%), oxygen desaturation (33%), and respiratory distress (27%) were the most frequent ones.

In VFSS, 15 children had isolated laryngeal penetration with thin liquid (33%) and 3 with thick liquid (14%). No child had isolated laryngeal penetration with homogeneous paste. Laryngeal aspiration was found in 15 children with thin liquid (33%) and in 5 with thick liquid (24%). Among the cases of laryngeal aspiration, 80% were silent with thin liquid and 100% with thick liquid. Only one child had laryngeal aspiration with homogeneous paste, but did not present CSS at CES with this consistency.

Accuracy of CES presented overall 86% sensitivity, with 95% confidence interval (95%CI 78–94), and 32% specificity (95%CI 15-47), and predictive positive value higher than the negative (Table 1). For isolated laryngeal penetration, CES had

Chart 1. Characterization of the subjects with respect to medical diagnoses

Type of problem	n	%
Neurological problem	29	53
Epilepsy, NSZ, or seizure	10	18
Cerebral palsy HIE	10	18
Neonatal asphyxia	9	16
Hydrocephalus and intracranial hypertension	8	15
Delay in psychomotor development	4	7
Periventricular hemorrhage	4	7
Leukomalacia	4	7
Microcephaly	3	5
Meningitis	2	4
Mononeuropathy	1	2
Leukodystrophy	1	2
Stroke	1	2
Hypotonia	1	2
Heart condition	12	22
PDA, PFO, and/or IAC	11	20
Scimitar syndrome	1	2
Respiratory condition	51	93
Wheezing attacks	22	40
Pneumonia	21	38
Bronchiolitis	17	31
Bronchopulmonary dysplasia	13	24
Respiratory distress syndrome	10	18
Laryngitis	5	9
Cyanosis	5	9
Acute respiratory failure/respiratory distress	4	7
Apnea	4	7
Cough	1	2
Bronchospasm	1	2
Others		
Prematurity	32	58
Down syndrome	1	2

Caption: NSZ = neonatal seizures; HIE = hypoxic-ischemic encephalopathy; PDA = patent ductus arteriosus; PFO = patent foramen ovale; IAC = interatrial communication

88% sensitivity (95%CI 69–98) (Table 2). In laryngeal aspiration, CES had 86% sensitivity (95%CI 70–96) (Table 3). However, specificity values and positive predictive values of CES were low for both changes (Tables 2 and 3). In addition, there was no significant association between CES and the findings of VFSS, in general (Table 1) and in cases of changes (Tables 2 and 3).

When the association between CSS and changes in the pharyngeal phase was verified, choking was the only CSS associated with laryngeal penetration with isolated thin liquid (p=0.044) (Table 4). There was no significant association between CSS and laryngeal aspiration (Table 5).

In detection of isolated laryngeal penetration with thin liquid, choking had a 53% sensitivity (95%CI 31-73), 77% specificity (95%CI 65-87), 53% positive predictive value (95%CI 31-73) and 77% negative predictive value (95%CI 65-87).

DISCUSSION

We highlighted the importance of conducting studies that compare the clinical evaluation with VFSS and the accuracy of CES in the detection of changes in the pharyngeal phase to contribute with scientific evidence for Speech Language

Table 1. Accuracy of clinical examination of swallowing to detect isolated laryngeal penetration and/or aspiration

Changes at CES	Changes at VFSS						p-value
	Present		Absent		Total		
	n	%	n	%	n	%	
Present	31	56	13	24	44	80	0.119
Absent	5	9	6	11	11	20	
Total	36	65	19	35	55	100	

χ^2 Test (p-value≤0.05); 86% sensitivity (95%CI 78–94); 32% specificity (95%CI 15–47); 71% positive predictive value (95%CI 63–77); 55% negative predictive value (95%CI 26–80)

Caption: CES = clinical evaluation of swallowing; VFSS = videofluoroscopic swallowing study

Table 2. Accuracy of clinical examination of swallowing to detect isolated laryngeal penetration

Changes at CES	VFSS — isolated laryngeal penetration						p-Value
	Present		Absent		Total		
	n	%	n	%	n	%	
Present	15	27	29	53	44	80	0.525
Absent	2	4	9	16	11	20	
Total	17	31	38	69	55	100	

Fisher's exact test (p-value≤0.05); 88% sensitivity (95%CI 69–98); 24% specificity (95%CI 15–28); 34% positive predictive value (95%CI 27–38); 82% negative predictive value (95%CI 52–97)

Caption: CES = clinical evaluation of swallowing; VFSS = videofluoroscopic swallowing study

Table 3. Accuracy of clinical examination of swallowing to detect laryngeal aspiration

Changes at CES	VFSS — laryngeal aspiration						p-Value
	Present		Absent		Total		
	n	%	n	%	n	%	
Present	18	33	26	47	44	80	0.639
Absent	3	5	8	15	11	20	
Total	21	38	34	62	55	100	

Fisher's exact test (p-value≤0.05); 86% sensitivity (95%CI 70–96); 24% specificity (95%CI 14–30); 41% positive predictive value (95%CI 33–46); 73% negative predictive value (95%CI 42–92)

Caption: CES = clinical evaluation of swallowing; VFSS = videofluoroscopic swallowing study

Table 4. Association between clinical signs and symptoms and presence of isolated laryngeal penetration in swallowing videofluoroscopy

Clinical evaluation			VFSS — isolated laryngeal penetration									
			Thin liquid (n=45)					Thick liquid (n=21)				
			Yes		No		p-Value	Yes		No		p-Value
			n	%	n	%		n	%	n	%	
Clinical signs	General	Yes	13	87	24	80	0.699	1	33	12	67	0.531
		No	2	13	6	20		2	67	6	33	
	CCA	Yes	5	33	15	50	0.289[a]	0	0	10	56	0.214
		No	10	67	15	50		3	100	8	44	
	CVQ	Yes	1	7	3	10	1.000	0	0	1	6	1.000
		No	14	93	27	90		3	100	17	94	
	CRR	Yes	2	13	1	3	0.254	0	0	1	6	1.000
		No	13	87	29	97		3	100	17	94	
	CHR	Yes	0	0	1	3	1.000	0	0	1	6	1.000
		No	15	100	29	97		3	100	17	94	
	$DSpO_2$	Yes	3	20	6	20	1.000	1	33	6	33	1.000
		No	12	80	24	80		2	67	12	67	
	Cough	Yes	3	20	11	37	0.321	0	0	5	28	0.549
		No	12	80	19	63		3	100	13	72	
	Choking	Yes	8	53	7	23	0.044*[a]	0	0	5	28	0.549
		No	7	47	23	77		3	100	13	72	
	Cyanosis	Yes	1	7	2	7	1.000	0	0	1	6	1.000
		No	14	93	28	93		3	100	17	94	
	RD	Yes	3	20	9	30	0.722	1	33	5	28	1.000
		No	12	80	21	70		2	67	13	72	
Total			15	100	30	100		3	100	18	100	

[a]χ^2 Test; *Statistically significant (p-value≤0.05) — Fisher's exact test

Caption: VFSS = videofluoroscopic swallowing study; CCA = change in cervical auscultation; CVQ = change in voice quality; CRR = change in respiratory rate; CHR = change in heart rate; $DSpO_2$ = oxygen desaturation; RD = respiratory distress

Pathology and Audiology treatment in child dysphagia, once few studies comparing these assessments and verifying the accuracy of CES in children have been made.

In addition, identification of CSS associated with changes in the pharyngeal phase is important to increase the accuracy of clinical assessment and detect such changes because in many cases the professionals must define their actions only based on this evaluation, and accurate diagnosis is essential for an appropriate therapeutic planning.

It is important to note that the subjects in this study formed a heterogeneous group of children with different concomitant health problems, with higher prevalence of respiratory and neurological problems, and history of prematurity. Heterogeneous groups of subjects were also found in other studies of clinical and VFSS in children[4,13,24].

In this study, CES presented overall 86% sensitivity and 32% specificity, which confirms the findings of other studies reporting 80–92% sensitivity and 25–47% specificity for clinical evaluation in the change detection in the pharyngeal phase[13,14]. In addition, they found a positive predictive value higher than the negative, which differs from that of other studies showing similar values for both[14] or the opposite[13]. These findings showed that the CES properly detected 86% children with changes in the pharyngeal phase of swallowing. However, the high proportion of false positives — children with CSS, but without changes — reduced the assessment specificity.

In CES, for isolated laryngeal aspiration and laryngeal penetration, 88% and 86% sensitivities were observed in this study, respectively. Similarly, another study showed 80% sensitivity for penetration and 92% for suction with liquid[4]. When analyzing the accuracy of CES by type of change in the pharyngeal phase, the specificity values and positive predictive values were low, which corroborates the same study's findings[4]. This may be explained by the high proportion of false positives in the variables analyzed.

Overall, in this study, there was no association between CES and the findings of the VFSS, similar to the findings of the other studies[9,13]. The same was true when food consistencies were considered separately. In contrast, another study showed a significant association between clinical assessment and penetration and aspiration with liquid[4].

Changes in cervical auscultation, cough, oxygen desaturation, and respiratory distress were frequent CSS in this population. The high prevalence of respiratory problems found in the subjects of our sample (93%) may have influenced the assessment of those

Table 5. Association between clinical signs and symptoms and presence of laryngeal aspiration in swallowing videofluoroscopy

Clinical evaluation			VFSS — laryngeal aspiration								
			Thin liquid (n=45)					Thick liquid (n=21)			
			Yes		No		p-Value	Yes		No		p-Value
			n	%	n	%		n	%	n	%	
Clinical signs	General	Yes	14	93	23	77	0.236	4	80	9	56	0.607
		No	1	7	7	23		1	20	7	44	
	CCA	Yes	9	60	11	37	0.138[a]	3	60	7	44	0.635
		No	6	40	19	63		2	40	9	56	
	CVQ	Yes	2	13	2	7	0.591	0	0	1	6	1.000
		No	13	87	28	93		5	100	15	94	
	CRR	Yes	1	7	2	7	1.000	0	0	1	6	1.000
		No	14	93	28	93		5	100	15	94	
	CHR	Yes	1	7	0	0	0.333	0	0	1	6	1.000
		No	14	93	30	100		5	100	15	94	
	$DSpO_2$	Yes	5	33	6	20	0.464	3	60	4	25	0.280
		No	10	67	24	80		2	40	12	75	
	Cough	Yes	7	47	7	23	0.172	2	40	3	19	0.553
		No	8	53	23	77		3	60	13	81	
	Choking	Yes	4	27	11	37	0.738	2	40	3	19	0.553
		No	11	73	19	63		3	60	13	81	
	Cyanosis	Yes	2	13	1	3	0.254	0	0	1	6	1.000
		No	13	87	29	97		5	100	15	94	
	RD	Yes	4	27	8	27	1.000	1	20	5	31	1.000
		No	11	73	22	73		4	80	11	69	
Total			15	100	30	100		5	100	16	100	

Fisher's exact test (p-value≤0.05); [a]χ^2 test

Caption: VFSS = videofluoroscopic swallowing study; CCA = change in cervical auscultation; CVQ = change in voice quality; CRR = change in respiratory rate; CHR = change in heart rate; $DSpO_2$ = oxygen desaturation; RD = respiratory distress

signals, which may explain the high proportion of false-positive results and the consequent lack of association between the variables.

With regard to identification of CSS associated with changes in the pharyngeal phase of swallowing, choking was the only one associated with isolated laryngeal penetration with thin liquid in this study. In addition, choking also presented higher specificity compared to sensitivity, and the negative predictive value was higher than the positive to detect that change. Other studies have also shown the same difference values when evaluating the accuracy of other CSS to detect changes in the pharyngeal phase[11,15].

Some authors[4] have reported cough as the main indicator of thin liquid penetration and aspiration; however, another study[11] questioned this finding because the authors did not define laryngeal penetration and aspiration occurred with the same consistency. Therefore, cough may be related only to suction, not to penetration. This study considered the definition of isolated penetration in accordance with the literature[11], and thus, the association found was not related to other changes in the pharyngeal phase.

The literature reports an association between cough, wet voice and noisy breathing, and thin liquid aspiration[4,11]. In contrast, in this study, cough and change in voice quality were not associated with any change in the pharyngeal phase. Furthermore, there was no association between CSS and laryngeal aspiration, which may be due to the high prevalence of silent aspiration found in the subjects of this study, also evidenced by the high proportion of false negatives observed in the CSS analyzed.

Some studies showed a significant relationship between change in cervical auscultation and laryngeal penetration and aspiration in children with neurological disorders[10,15]. In this study, although change in cervical auscultation was the most common clinical sign, it was not associated with the changes in pharyngeal phase found at VFSS. This may be explained by the high prevalence of respiratory problems in the subjects in this study (93%), which may have influenced the assessment of the sign.

These findings showed that the CSS evaluated in this study made CES more accurate to detect changes in the pharyngeal phase, but not CSS alone. However, the high proportion of false positives and the high prevalence of silent aspiration support the importance of complementing CES with objective evaluations, such as VFSS, to identify changes in swallowing properly[1,2,7].

The findings of this study are important for speech therapy clinical practice, as they proved CES to be sensitive to detect

changes in the pharyngeal phase. In addition, they stressed the importance of observing the presence of choking with thin liquid in CES, for it has been related to isolated laryngeal penetration. However, the high proportion of false positives found in CES and the high prevalence of silent aspiration at VFSS gave support to the need of complementing CES with objective swallowing evaluation, such as VFSS in children with suspected dysphagia.

Despite the fact that this study was limited for being a retrospective analysis, the use of PAD-PED[16], a protocol with definitions and parameters defined based on the literature, it was consistent in the collection of clinical evaluation data. To strengthen the care with which the study was conducted, one can point as bias in data collection the fact that speech therapy clinical evaluations and fluoroscopic study were performed by the same researcher.

Further prospective studies with rigorous methodological design and a larger sample are needed to confirm the results of this research. In this way, there will be more scientific evidence for speech therapy clinical practice regarding child dysphagia.

CONCLUSIONS

CES was sensitive to detect isolated laryngeal penetration and aspiration. However, the high proportion of false positives decreased the specificity assessment.

Choking was the only CSS associated with isolated laryngeal penetration with thin liquid and presented a greater specificity compared to sensitivity to detect this change. There was no association between the CSS and laryngeal aspiration.

We must highlight the importance of complementing CES with an objective evaluation of swallowing, such as VFSS, in children with suspected dysphagia due to the high proportion of false positives observed in CES and to the high prevalence of silent aspiration during the VFSS in this population. In addition, the speech therapist should be aware of the presence of choking in CES with thin liquid because of the possible occurrence of isolated laryngeal penetration.

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